

IN THE CLAIMS

This listing of claims will replace all prior versions, and listings, of claims in the application.

Claim 1 (Currently Amended) A motion control system, comprising:

a central controller configured to generate first and second demand control signals defining actuation motion of respective first and second actuators, the central controller comprising a propagation delay parameter measuring mechanism configured to measure first and second propagation delay parameters between the central controller and respective first and second slaves, the first and second propagation delay parameters being communicated to the respective first and second slaves;

the first and second slaves in communication with said central controller, each slave comprising,

at least a respective one of said actuators configured to implement at an actuator time an action based upon said respective demand control signal, and

a memory configured to store ~~at least one~~ the respective propagation delay parameter communicated by the central controller ~~related to a signal propagation delay between the central controller and each of said first and second slaves[[]], and~~

a phase-locked loop timing mechanism configured to establish timing at which the respective actuator is to be actuated ~~at each slave based on the respective propagation delay parameters, said timing mechanism being adjusted~~ configured to delay reception of a servo clock message at said first and second slaves by an amount of time corresponding to the respective propagation delay parameters- parameter for information passed from the central controller to the first and second slaves respective

slave so that the actuator times of actuators at each of said first and second slaves occur simultaneously; and

a data network configured to place said first and second slaves in communication with said central controller and by which the first and second delay parameters are communicated from the central controller to the respective first and second slaves.

Claim 2 (Currently Amended) The system according to claim 1, wherein:

said first and second slaves further comprise respective transducers configured to measure at a transducer time respective parameters related to motion of respective ~~of~~ said actuators and to generate respective feedback signals;

said central controller is configured to receive said respective feedback signals indicative of motion of said first and second actuators; and

said timing mechanism at each slave is configured to establish timing at each slave based on the respective propagation delay parameter so that said transducer times occur simultaneously at the slaves.

Claim 3 (Currently Amended) The system according to claim 1, wherein:

said first slave further comprises a transducer configured to measure at a transducer time a parameter related to motion of said first actuator and to generate a first feedback signal;

said central controller is configured to receive said first feedback signal indicative of motion of said first actuator; and

said timing mechanism at said first slave is configured to establish timing at said first slave based on the ~~first at~~ respective propagation delay parameter so that said transducer time at said first slave occurs at a known time relative to a master time.

Claim 4 (Previously Presented) The system according to claim 1, wherein at least one of said first and said second slaves further comprises a current/torque controller.

Claim 5 (Previously Presented) The system according to claim 1, wherein:  
said central controller comprises a synchronization signal generator configured to generate a synchronization signal; and  
said timing mechanism comprises a synchronization signal receiver configured to receive said synchronization signal.

Claim 6 (Currently Amended) The system according to claim 5, wherein said timing mechanism further comprises:

an adder configured to add each said respective propagation delay parameters to an arrival time of said synchronization signal to provide said actuator time for each actuator.

Claim 7 (Previously Presented) The system according to claim 5, wherein said slaves each further comprise a local clock.

Claim 8 (Currently Amended) The system according to claim 7, wherein said timing mechanism further comprises:

a local clock setting mechanism configured to set each said local clock based on said synchronization signal and said respective propagation ~~time~~ delay parameters along said data network from said central controller to each slave.

Claim 9 (Previously Presented) The system according to claim 2, wherein:

said central controller comprises a synchronization signal generator configured to generate a synchronization signal; and

said timing mechanism comprises a synchronization signal receiver configured to receive said synchronization signal.

Claim 10 (Previously Presented) The system according to claim 9, wherein said timing mechanism comprises:

an adder configured to add said respective propagation delay parameters to an arrival time of said synchronization signal to provide at least one of said actuator time and said transducer time.

Claim 11 (Currently Amended) The system according to claim 10, wherein:

said slaves each further comprise a local clock; and

said timing mechanism further comprises a local clock setting mechanism provided at each slave and configured to set said local clock based on said synchronization signal and said respective propagation time delay parameter along said data network from said central controller to each slave.

Claim 12 (Previously Presented) The system according to claim 1, wherein said central controller comprises a master controller.

Claim 13 (Original) The system according to claim 1, wherein said data network comprises a tree topology.

Claim 14 (Original) The system according to claim 1, wherein said data network comprises a ring topology having a forward direction and a reverse direction.

Claim 15 (Original) The system according to claim 14, wherein said ring topology comprises a full duplex ring.

Claim 16 (Previously Presented) The system according to claim 14, wherein said central controller further comprises:

a transmitter configured to transmit a signal along said ring topology; and

a receiver configured to receive an answer to said signal, said answer transmitted along said ring topology.

Claim 17 (Currently Amended) The system according to claim 16, wherein said central controller further comprises:-an identifier configured to identify a ~~furthest~~ farthest slave along said ring topology in a forward direction from which said answer ~~can be~~ is configured to be received at said receiver.

Claim 18 (Previously Presented) The system according to claim 14, wherein said propagation delay parameter memory comprises: a forward path propagation delay parameter portion configured to store a parameter related to a propagation delay from said central controller in a forward direction along said forward direction to said slave; and a reverse path propagation delay parameter portion configured to store a parameter related to a propagation delay from said central controller in a reverse direction along said reverse direction to said slave.

Claim 19 (Previously Presented) The system according to claim 1, wherein said central controller is configured to autoenumerate said first and second slaves.

Claim 20 (Previously Presented) The system according to claim 1, wherein said central controller further comprises:

a query message transmitter configured to transmit a query message along said data network; and

an answer message receiver configured to receive an answer to said query message, and each of said first and second slaves comprises,

a query message receiver configured to receive said query message from said central controller, and

an answer message transmitter configured to transmit an answer message replying to a received query message, said answer message transmitted along said data network, said answer message enumerating said slave.

Claim 21 (Previously Presented) The system according to claim 20, wherein said first slave further comprises:

a relay configured to pass along said query message to said second slave when said first slave has already been enumerated.

Claim 22 (Previously Presented) The system according to claim 20, wherein said second slave further comprises:

a relay configured to pass along said query message to said central controller when said second slave has already been enumerated.

Claim 23 (Original) The system according to claim 20, wherein:

said query message is transmitted in a forward direction; and  
said answer message is transmitted in a reverse direction.

Claim 24-69 (Canceled)

Claim 70 (New) A motion control system comprising:

a central controller configured to generate first and second demand control signals defining actuation motion of respective first and second actuators;

first and second slaves in communication with said central controller, each slave comprising,

at least a respective one of said actuators configured to implement at an actuator time an action based upon said respective demand control signal, and

a memory configured to store at least one respective propagation delay parameter related to a signal propagation delay between the central controller and each of said first and second slaves,

a timing mechanism configured to establish timing at each slave based on the respective propagation delay parameters, said timing mechanism configured to delay reception of a servo clock message at said first and second slaves by an amount of time corresponding to the propagation delay parameters for information passed from the central controller to the first and second slaves so that the actuator times at each of said first and second slaves occur simultaneously; and

a data network configured to place said first and second slaves in communication with said central controller, wherein said data network comprises a ring topology having a forward direction and a reverse direction, and said central controller further comprises a transmitter configured to transmit a signal along said ring topology, a receiver configured to receive an answer to said signal, said answer transmitted along said ring topology, and an identifier configured to identify a farthest slave along said ring topology in a forward direction from which said answer is configured to be received at said receiver.

Claim 71 (New) A motion control system comprising:

a central controller configured to generate first and second demand control signals defining actuation motion of respective first and second actuators;

first and second slaves in communication with said central controller, each slave comprising,

at least a respective one of said actuators configured to implement at an actuator time an action based upon said respective demand control signal, and



a memory configured to store at least one respective propagation delay parameter related to a signal propagation delay between the central controller and each of said first and second slaves,

a timing mechanism configured to establish timing at each slave based on the respective propagation delay parameters, said timing mechanism configured to delay reception of a servo clock message at said first and second slaves by an amount of time corresponding to the propagation delay parameters for information passed from the central controller to the first and second slaves so that the actuator times at each of said first and second slaves occur simultaneously; and

a data network configured to place said first and second slaves in communication with said central controller, wherein said data network comprises a ring topology having a forward direction and a reverse direction, and said propagation delay parameter memory comprises a forward path propagation delay parameter portion configured to store a parameter related to a propagation delay from said central controller in a forward direction along said forward direction to said slave and a reverse path propagation delay parameter portion configured to store a parameter related to a propagation delay from said central controller in a reverse direction along said reverse direction to said slave.

Claim 72 (New) A motion control system comprising:

a central controller configured to generate first and second demand control signals defining actuation motion of respective first and second actuators;

first and second slaves in communication with said central controller, each slave comprising,

at least a respective one of said actuators configured to implement at an actuator time an action based upon said respective demand control signal, and

a memory configured to store at least one respective propagation delay parameter related to a signal propagation delay between the central controller and each of said first and second slaves,

a timing mechanism configured to establish timing at each slave based on the respective propagation delay parameters, said timing mechanism configured to delay reception of a servo clock message at said first and second slaves by an amount of time corresponding to the propagation delay parameters for information passed from the central controller to the first and second slaves so that the actuator times at each of said first and second slaves occur simultaneously; and

a data network configured to place said first and second slaves in communication with said central controller, wherein said central controller further comprises a query message transmitter configured to transmit a query message along said data network, and an answer message receiver configured to receive an answer to said query message, and each of said first and second slaves further comprises a query message receiver configured to receive said query message from said central controller, and an answer message transmitter configured to transmit an answer message replying to a received query message, said answer message transmitted along said data network, said answer message enumerating said slave.

Claim 73 (New) The system according to claim 72, wherein said first slave further comprises:

a relay configured to pass along said query message to said second slave when said first slave has already been enumerated.

Claim 74 (New) The system according to claim 72, wherein said second slave further comprises:

a relay configured to pass along said query message to said central controller when said second slave has already been enumerated.

Claim 75 (New) The system according to claim 72, wherein:  
said query message is transmitted in a forward direction; and  
said answer message is transmitted in a reverse direction.